

# **One or More Labels on the Bottles? Notional Concord in Dutch and French**

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Three experiments, the first two in Dutch and the other in French, in which subject-verb agreement errors were induced, are reported. We investigated the effects of the number of tokens in the conceptual representation of the to-be-uttered subject noun phrase (i.e. distributivity). Previous studies have failed to show an effect of this variable in English (Bock & Miller, 1991; Vigliocco, Butterworth, & Garrett, in press). However, Vigliocco, Butterworth and Semenza (1995) and Vigliocco et al. (in press) did find an effect of distributivity in Italian and Spanish. In an attempt to account for this difference across languages, three structural differences between English and Spanish/Italian have been considered: (1) richness of verbal morphology; (2) possibility of post-verbal subjects; (3) possibility of null subjects. In the present study, we tested French and Dutch, which share some but not all of these

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properties with Italian and Spanish. In both languages, a distributivity effect was obtained, a result which strongly supports an account in which neither null subjects nor post-verbal subjects are the main determinants, across languages, of their different sensitivities to conceptual factors.

## INTRODUCTION

Most languages require the verb to agree in number with the subject of the sentence. In the language production literature, it is assumed that agreement is computed at the stage of *grammatical encoding* (Levelt, 1989). During this stage, lexical representations are retrieved, and the syntactic structure of the sentence is constructed, on the basis of the information specified in the discourse model (Bock & Levelt, 1994; Garrett, 1976). Getting subject–verb agreement right involves the speaker accessing a set of conceptual, syntactic and morphological information. Access itself is controlled by a number of processes: selection of a discourse element as head of a noun phrase, access to the lexical representation of the noun, selection of the appropriate number and gender features for it, assignment of this noun to the subject function, selection of a predicate, access to the corresponding lexical representation, selection of features such as tense and mood, and finally some processes that ensure the same person and number features on the subject and on the verb. Each step can in principle go wrong, but subject–verb agreement is usually constructed correctly and effortlessly in spontaneous speech. However, from time to time errors occur. In (1)–(3), examples of subject–verb agreement errors are presented (taken from a sample of written English; Strang, 1966, pp. 78–79):

1. It is then this world of dreams created in the idle brain which *take* out the realm of reality into the sphere of self-deception.
2. This country house group *divert* themselves in genteel ways, walking and talking, roaming the countryside and viewing the estate.
3. He therefore is presenting the Yashoos as a symbol of what “man” considered “en masse” *are* becoming.

Two major categories of errors have been discussed by descriptive grammarians (Quirk, Greenbaum, Leech, & Svartvik, 1972):

- *Proximity concord*, where the verb agrees with a noun that is closer to the verb than the subject noun, as in (1), where the verb *take* agrees with the closer plural noun *dreams* instead of the singular subject *world*.
- *Notional concord*, where the verb agrees with the “notional number” (instead of the grammatical number) of the subject. In (2), the verb *divert* agrees with the plural meaning of the subject head noun *group*, instead of its grammatical singular number. A similar account can be

given for the error reported in (3), where the conceptual reading of the subject noun *man* seems to be *all the men*.

These two forms of derailment have been studied in series of experiments designed to induce agreement errors (Bock & Cutting, 1992; Bock & Eberhard, 1993; Bock & Miller, 1991; Fayol, Largy, & Lemaire, 1994; Vigliocco, Butterworth, & Semenza, 1995; Vigliocco, Butterworth, & Garrett, in press). In most of these experimental investigations, subject-verb agreement errors were induced by presenting the participants with preambles consisting of a subject head noun and a local noun embedded in a phrase or clause that modified the subject noun phrase, as shown in (4) and (5). The participants' task was to provide a sentential completion for the preamble.

4. The king of the colonies.
5. The king of the colony.

All these studies reported a *proximity effect*. That is, the presence of a local noun, mismatching in number with the subject head noun, and in the immediate pre-verbal environment, as in (4), increased subject-verb agreement error rates in comparison to the number control condition, exemplified in (5), where the head and the local noun had the same number features (Bock & Cutting, 1992; Bock & Eberhard, 1993; Bock & Miller, 1991; Fayol et al., 1994; Vigliocco et al., 1995, in press).

The question whether speakers produce verbs that agree with the conceptual number of the subject instead of its grammatical number (i.e. *notional concord*) has also been addressed (Bock, Eberhard, & Cutting, 1992; Bock & Eberhard, 1993; Bock & Miller, 1991; Vigliocco et al., 1995, in press), but the results have differed across languages.

One of the conceptual variables that has received the most attention in these studies is *distributivity*. We indicate with this label the number of "tokens" a singular head noun can refer to. For example, in the discourse model of a preamble such as (6), there will be just one baby sitting on a number of blankets, as shown in Fig. 1a. Preambles of this sort are called *single token preambles*. In (7), instead, there will be a label on each of several bottles, in order for the preamble to be in line with our world knowledge. This is depicted in Fig. 1b. In fact, if we attempt to interpret the preamble in (7) as a single token preamble, we would end up with the representation depicted in Fig. 1c, which is possible to imagine, but incompatible with what we know about the relation between "bottles" and "labels". These sentential preambles are called *multiple token preambles*. In these preambles, the subject NP refers to an entity distributed over multiple objects.

6. The baby on the blankets.

## 7. The label on the bottles.

For single token preambles, the conceptual number is singular and congruent with the grammatical number of the head noun, whereas for multiple token preambles the conceptual number is plural and conflictual with the singular grammatical number.<sup>1</sup>

Bock and Miller (1991) reported that this variable did not affect subject-verb agreement error rates for English-speaking subjects: errors in the agreement of number were equally common after a preamble such as (6) and a preamble such as (7). This result has also been replicated by Vigliocco et al. (in press) with slightly different materials and with a different population. However, an effect of the conceptual number of the subject on the rates of subject-verb agreement errors has been reported by Vigliocco et al. (1995, in press), who showed that speakers of Italian and Spanish were sensitive to distributivity: subject-verb agreement errors were more frequent for multiple than for single token items.

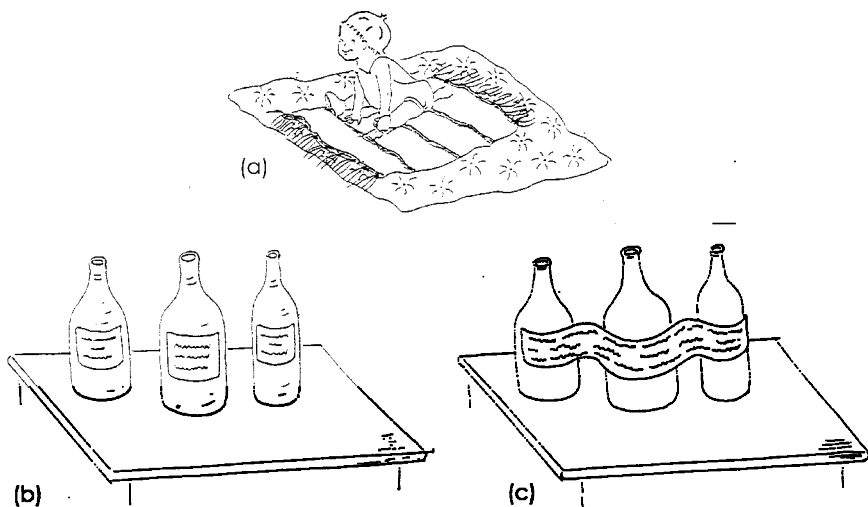


FIG. 1. An interpretation of the preambles "The baby on the blankets" (1a) and "The label on the bottles" (1b and 1c). For single token preambles such as (1a), an interpretation whereby there is just one baby sitting on a number of blankets will be in agreement with our world knowledge. For multiple token preambles such as (1b), only an interpretation whereby there are many labels, one for each bottle, will there be agreement with our world knowledge. A single token interpretation of such a preamble would result in the bizarre scenario depicted in (1c).

<sup>1</sup>Note, however, that this distinction only applies if a *token* interpretation is considered. If for multiple token items we consider a *type* interpretation, then the conceptual number of the head noun would be singular and congruent with its grammatical number.

This is not to say that English speakers are *never* sensitive to the conceptual number of the subject head noun. Bock and colleagues (Bock et al., 1992; Bock, 1995) reported some data showing semantic effects in English subject-pronoun agreement. Bock et al. (1992) presented complete sentences with single or multiple token complex subject NPs to speakers of English, who were requested to add a “tag” question at the end, as in (8), with the correct completion in square brackets:

8. The bridge to the islands broke. [Didn't it?]

Bock et al. found that plural pronouns were produced more often after a multiple token than after a single token preamble. In another series of experiments (reported in Bock, 1995; Eberhard, personal communication), they found that collective head nouns (e.g. *gang*, *committee*) induced a very high percentage of plural verbs (~ 40%) as well as a very high percentage of plural pronouns (~ 50–60%). In those experiments, speakers of US English were given sentential preambles such as in (9a) or sentences such as in (9b), and their task was to provide a completion which contained the verb (for 9a) or which contained just the reflexive pronoun (for 9b):

- 9a. The gang with the dangerous rivals ...  
 b. The gang with the dangerous rivals armed ...

These results show conceptual control of subject-pronoun agreement but also of subject-verb agreement, a result that contrasts with the data on distributivity reported above. However, it can be argued that collective nouns represent a particular case in English, as demonstrated by the fact that in British English a plural verb in (9a) would be grammatical. Even in US English, while “The leader with the dangerous rivals ARE arming themselves” is a genuine error, the matter seems less clear for “The gang with the dangerous rivals ARE arming themselves”.<sup>2</sup>

In this paper, we discuss three hypotheses put forward to account for the different sensitivities of English and Italian/Spanish to conceptual factors (Vigliocco et al., in press). In order to narrow down the number of hypotheses, we conducted a series of experiments in French and Dutch.

In most models of speech production, agreement is computed during *grammatical encoding* (Bock & Levelt, 1994; Levelt, 1989), and more specifically after grammatical functions have been assigned (Bock & Levelt, 1994) but prior to a stage in which words are placed in their linear order (Bock & Cutting, 1992; Vigliocco & Nicol, in prep.). Traditionally in the linguistic literature, agreement has been described as a copying of features from the subject to the verb (see, for example, Akmajian & Heny, 1975;

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<sup>2</sup>Note also the very high error rates induced by collective head nouns (~ 40%) in contrast to control count nouns (~ 18%).

Chomsky, 1981), and most psycholinguistic models (Bock & Miller, 1991; Garrett, 1982; Kempen & Hoenkamp, 1987; Levelt, 1989) have assumed the same view. However, an alternative view has also been proposed: unification or feature merging (Barlow, 1993; De Smedt, 1990; Kempen & Vosse, 1989). According to this second possibility, the features for the subject and the features for the verb can be independently retrieved from the discourse model, and then a checking procedure (unification) ensures that the two elements are compatible. Agreement is therefore computed as a merging of compatible features carried by the agreeing elements (in our case, the subject and the verb).

We have argued that the finding of a distributivity effect implies that the number features for the two agreeing elements can be independently retrieved from the discourse model (Vigliocco et al., 1995, in press). If the number feature was copied from the subject to the verb, then the conceptual number of the subject NP should be irrelevant (cf. Vigliocco et al., in press, for an extensive discussion of this issue).<sup>3</sup>

The problem to be solved is why, during the process that builds the syntactic representation of the sentence, the number can be retrieved for the verb phrase in Italian and Spanish, whereas this does not seem to be the case in English. In an attempt to account for the different behaviour of these languages, three cross-linguistic structural differences can be considered. These structural properties are as follows:

1. *The possibility of dropping the subject of the sentence versus having mandatory subjects.* If a language allows subjectless sentences, then the number marking of the verb may be retrieved directly from the discourse model. The lack of an explicit agreement *controller* (i.e. the subject pronoun) is to be considered normal for subject–verb agreement in Italian and Spanish. [For Italian, Bates (1976) reported that the subject NP is omitted in up to 70% of declarative sentences.] In English, verbs rarely lack an explicit controller for subject–verb agreement, but this is not true for subject–pronoun agreement, since in this case the referent can be just in the perceptual or discourse context. This hypothesis can account for cross-linguistic differences in subject–verb agreement and it can also account for the different behaviour in English of verbs and pronouns (cf. Bock, 1995). That is, in English (as in the other languages tested), the discourse model of the sentence influences agreement only when the grammatical controller is not overtly expressed. Of course, then, we must assume that for these agreement relations, even when the controller is overtly expressed, the conceptual referent may be used to compute agreement.

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<sup>3</sup>This seems to be the case especially for complex NPs, as were used in these experiments, where the conceptual plurality comes about only if the PP is taken into account.

2. *The possibility of having post-verbal as well as pre-verbal subjects versus a strict subject-verb-object (SVO) word order.* In Italian and Spanish, the subject NP can appear in the string long after the verb, as in (10) in Italian, whereas English does not allow post-verbal subjects:

10. E' andata dal dentista Daniela.  
Is gone to-the dentist Danielle.  
(Danielle went to the dentist.)

If we assume that the grammatical encoding of a sentence proceeds in an incremental fashion (De Smedt, 1990; Garrett, 1976, 1990; Kempen & Huijbers, 1983; Kempen & Hoenkamp, 1987; Levelt, 1989; Levelt & Maassen, 1981; Schriefers, 1993), then the verb can start to be phonologically encoded *before* the encoding of the subject is completed. If that is the case, the number specification for the verb has to be retrieved first from the discourse model. Because in English declarative sentences the subject *always* precedes the verb, there is no need to retrieve the number specification for the verb from the discourse model first and the verb can receive its number specification from the subject without delay in the ongoing encoding. Again, we need an additional assumption: That even when the subject is pre-verbal, in Italian and Spanish, the verb can receive its number from the discourse model. This hypothesis can account for the cross-linguistic variability we found; however, it is not clear how it could explain the difference between verbs and pronouns in English.

3. *Rich verbal inflectional system versus poor verbal morphology.* In Italian and Spanish, person and number are always expressed by the verb inflectional morphology, while this is not the case for English. Since in English in most cases there is no need to specify the number feature on the verb, it is conceivable that it is usually not retrieved from the discourse model. Furthermore, since number is always expressed on pronouns in English, this hypothesis could explain the different sensitivity to conceptual factors of verbs and pronouns.

In the present experiments, we used Dutch and French as the test languages, since they share some properties with Italian, Spanish and English but not others, so that we could manipulate, as much as nature allowed us, one or two of the properties described above while keeping the others constant. In these experiments, we asked speakers of Dutch and French to complete single and multiple token preambles of the sort reported in (6) and (7) above. In the following section, we mention the properties of Dutch and French which are relevant to our hypotheses.

Dutch (Geerts, Haeseryn, de Rooij, & van den Toorn, 1984; Kooij, 1990) does not allow subjectless sentences and, like in English, a "dummy" subject

is used when necessary (e.g. *het regent* [it rains]). It allows post-verbal subjects as exemplified in (11):

11. De bloemen op de tafel vindt Jan mooi.  
The flowers on the table finds John beautiful.  
(John finds the flowers on the table beautiful.)

Finally, the verb forms are *always* marked for number, while the person distinction is present only in the present tense as a contrast between first person singular versus second and third person singular (see Table 1 for an example). An exception to this is the verb “to be”, where person is differentially marked for each singular form. Therefore, Dutch resembles English in that it does not allow null subjects, but it also resembles Italian and Spanish in that the sentential subject can be post-verbal and the verb forms are univocally marked for number.

Dutch is also an interesting language to study because it allows us to test another difference across languages. Italian, Spanish and French are Romance languages, whereas English and Dutch are Germanic languages. Therefore, if we find a distributivity effect in Dutch, we can exclude the possibility that, for one reason or another, some characteristics of the family of Romance languages are responsible for conceptual influences on subject–verb agreement.

TABLE 1  
Example of Present Tense Conjugations for “to walk”  
and “to be” in Dutch

	<i>lopen</i> [to walk]	<i>zijn</i> [to be]
ik (I)	loop	ben
jij (you, S)	loopt	bent
hij/zij (he/she)	loopt	is
wij (we)	lopen	zijn
jullie (you, P)	lopen	zijn
zij (they)	lopen	zijn

In French, subjectless sentences are not allowed, and like Dutch and English, a “dummy” subject is used when necessary. French is regarded as a canonical SVO language (Harris & Vincent, 1990, p. 235) and therefore post-verbal subjects are not allowed.<sup>4</sup> In French, in the written format, verbs

<sup>4</sup>According to some authors (e.g. Harris & Vincent, 1990; Trévisé, 1986), the existence of two interrelated phenomena—the presence of clitic pronouns and the possibility of dislocating NPs—combine to give a relatively free word order. For example:

la table il la touche le garçon  
the-F,S table-F,S he-M,S it-F,S touches the-M,S boy-M,S

However, in these constructions, the subject pronoun is always pre-verbal.



TABLE 2  
Example of Present Tense Conjugations for Irregular ("to be" and "to do") and Regular  
("to find") Verbs

	<i>être [to be]</i>	<i>faire [to do/make]</i>	<i>trouver [to find]</i>
je (I)	suis	fais*	trouve*
tu (you, S)	es	fais*	trouves*
il/elle (he/she)	est	fait*	trouve*
nous (we)	sommes	faisons	trouvons
vous (you, P)	êtes	faites	trouvez
ils/elles (they, M/F)	sont	font	trouvent*

*Note:* Forms within a column marked with an asterisk are pronounced identically.

are always marked for person and number. However, in spoken language, the matter is more complex. Simplifying, in the present indicative there are six main conjugation types in French (Harris & Vincent, 1990, p. 224). For all of these conjugation types, the person distinction is absent in the singular forms. In addition, for two of these conjugation types (e.g. "donner" and "ouvrir"), the third person plural is pronounced as the singular forms. For irregular verbs, such as "to be", both person and number distinction is maintained (see Table 2 for an example).<sup>5</sup>

Although the number distinction on the verb, which is crucial for our argument, is not always expressed in spoken language, we would like to argue that number is also represented as a syntactic feature during grammatical encoding of regular verbs, since it is overtly expressed in the written format. Therefore, French resembles English in that the subject is always overtly expressed and always in pre-verbal position, but it resembles Italian and Spanish in that its verbal morphology is richer than English. It is also important to note that French is a *Romance* language, like Italian and Spanish. In Table 3, we provide a summary describing the relevant characteristics of the different languages.

A word of caution is necessary here. We acknowledge that properties such as allowing post-verbal subjects and richness of verbal morphology are a matter of degree, rather than absolute. For example, although Dutch allows post-verbal subjects, this syntactic construction is not as common in Dutch as it is in Italian or Spanish. Dutch and French verbal morphology is richer than English verbal morphology, but at the same time is not as rich as it is in Italian or Spanish.

<sup>5</sup>In general, the more frequent a verb is in spoken language, the more likely it is to preserve the distinction between third singular and third plural form. McDonald and Heilenman (1991) pointed out that of the 20 most frequent French verbs, 65% retain this distinction, whereas of the 20 most infrequent verbs, only 10% do.

TABLE 3  
Summary of the Characteristics Shown by the Different  
Languages

	<i>Null Subjects</i>	<i>Post-verbal Subjects</i>	<i>Rich Verbal Morphology</i>
Italian	+	+	+
Spanish	+	+	+
Dutch	—	+	+
French	—	—	+
English	—	—	—

### The Plan of the Study

In this study, we report a series of three experiments in which speakers of Dutch and French were requested to repeat and complete single token and multiple token preambles. From the discussion above, we can derive the following predictions. First, in both Dutch and French, the subject pronoun is mandatory, and therefore they resemble English in this respect. If the possibility of dropping the subject is the only factor determining the sensitivity of a language to conceptual number, then we should find the same result we obtained in English—that is, no difference between single token and multiple token preambles. If a difference is found, we must conclude that the lack of an explicit controller for the agreement relation is not a necessary condition for the independent retrieval of number features from the discourse model. Second, Dutch allows post-verbal subjects, while French does not. If the possibility of having subjects after the verb is important for having conceptual number effects in a language, then Dutch should behave like Italian/Spanish, while French should behave like English. Third, the verbal morphology of Dutch and French is richer than that of English. If indeed the presence of an *overt* number marking on the verb is a relevant factor, then Dutch and French should behave like Italian and Spanish.

Finally, using Dutch as a test language allows us to test whether other differences between Italian/Spanish and English may have contributed to the results reported in the literature. If the sensitivity to conceptual number is a characteristic of Romance languages only, then Dutch should behave like English (while French should behave like Italian and Spanish). Furthermore in English, number in the experimental noun phrases is only marked on the noun, since the determiner “the” does not carry number information; in Italian/Spanish, number is redundantly specified on both the determiner and the noun (e.g. “la macchina, le macchine”, “el coche, los coches” [the car/s]). Dutch allows control of this variable. In Dutch, number

marking on the determiner depends on the gender of the noun. The definite determiner of neuter nouns is marked for number (“het” in the singular, “de” in the plural), but the definite determiner preceding masculine/feminine nouns is not marked (always “de”). By using preambles with masculine/feminine subject nouns in Dutch, we create a situation similar to English—that is, only the subject noun is marked for number. If for whatever reason the presence of more than one morphological number marker in the NP (i.e. number marking on the determiner and on the noun *vs* number marking on the noun only) has an impact on the results, this may emerge in this study.

## EXPERIMENT 1: DUTCH

The first experiment tested whether speakers of Dutch are sensitive to the distributivity dimension. Single and multiple token items were visually presented to participants who were instructed to read them and to turn them into full sentences. Previous work (e.g. Bock & Miller, 1991; Vigliocco et al., 1995) has shown that agreement error incidence, even in experiments specifically designed to induce this kind of error, is very low ( $\sim 2\text{--}4\%$ ) and seems to be related (among other things) to speech rate (the instructions given to participants usually emphasise rapid speech). In an attempt to increase agreement error rates, we introduced a new methodology in this experiment. Preambles were briefly presented on the computer screen and were followed by a deadline signal after a short interval. The participants were instructed to produce the full sentence within this interval. For example, the participants saw “De datum op de munten” [The date on the coins] and had to say something like “De datum op de munten was oud” [The date on the coins was old] before the deadline signal. The main virtue of this methodology is that the rate of speech is kept as high as possible in a controlled fashion.

In order to ensure that possible differences between single and multiple token items can be reliably attributed to their different conceptual number (since the distributivity manipulation was necessarily confounded with items), the following controls were considered. First, analysis was not restricted to agreement errors but also included other kinds of errors in reading and completing the preambles. Furthermore, plausibility ratings for items classified as single and multiple token were collected for the same subjects, after they had finished the production experiment.

## Method

*Participants.* Thirty-two undergraduate students at the University of Nijmegen participated in the experiment, all of whom were native speakers of Dutch. They received course credits or Dfl. 5 for their participation.

*Materials.* The experimental materials comprised sentential fragments consisting of subject noun phrases (NPs) followed by prepositional phrases (PPs). All experimental preambles had a singular head noun. The preferred semantic reading of the preambles (i.e. single or multiple token) was evaluated by 10 independent judges, all native speakers of Dutch. Only those items classified as single or multiple tokens by at least seven judges were included in the experiment. There were 24 experimental items, 12 judged as single token and 12 judged as multiple token.

The number of the local noun was manipulated within items. Note that distributivity applied only to singular head noun and plural local noun sentential preambles where it is possible to contrast a singular to a plural reading of the sentential subject (e.g. one single road to several islands, or a label for each of several bottles); for items with a singular head noun followed by a singular local noun, the preferred reading is congruent with the syntactic characteristics of the subject (e.g. one road to one island, or one label on one bottle). Examples of items in the different experimental conditions are reported in Table 4.

Each preamble consisted of the same number of words ( $n = 5$ ). The number of syllables was on average higher in the single token set than in the multiple token set (7.6 vs 7.0), a difference that was not significant [ $t(22) = 1.47, P = 0.157$ ]. The experimental items all contained head and local nouns

TABLE 4  
Example of Experimental Sentence Preambles in Experiment 1  
(Dutch)

<i>Experimental Condition</i>	<i>Examples</i>
Single token, number match (ST, control)	De aanslag op de minister (The strike on the minister)
	De diefstal van de diamant (The theft of the diamond)
Single token, number mismatch (ST)	De aanslag op de ministers (The strike on the ministers)
	De diefstal van de diamanten (The theft of the diamonds)
Multiple token, number match (MT, control)	De afbeelding op de mok (The picture on the mug)
	De bon in de folder (The coupon in the flyer)
Multiple token, number mismatch (MT)	De afbeelding op de mokken (The picture on the mugs)
	De bon in de folders (The coupon in the flyers)

of the non-neuter gender; that is, they all started with the same definite determiner, “de”, which is unmarked for number and therefore can be considered parallel to the English “the”. All preambles are listed in Appendix 1.

There were 36 filler items, 24 of which had the same syntactic structure as the experimental items, but had a plural head noun. Half of these had a singular local noun and half a plural local noun. The remaining 12 fillers were simple NPs, consisting of a determiner, one or more adjectives, and a noun. The simple NP fillers were singular in six cases and plural in six cases. Filler items all had head nouns of the non-neuter gender.

Four 60-item lists were created. Each list consisted of 24 experimental items (six single token items, six single token control items, six multiple token items and six multiple token control items) and 36 fillers. In each list, the experimental and filler items were organised in a pseudo-random order, with the constraint that the list started with four fillers, and that no more than two experimental items followed each other. Across the four lists, each item occurred twice in the match condition and twice in the mismatch condition.

In the plausibility rating task, the same lists were used as in the production experiment.

*Procedure.* The participants were tested in individual sessions, lasting about 10 min. They were instructed to read aloud and complete the preambles that were presented on the computer screen. No instructions were given about the form of the completion, other than that a complete sentence had to be produced before the deadline signal.

A trial was initiated by a button press. A fixation point appeared after 1 sec in the centre of the screen. The preambles were presented visually at the centre of the screen. Presentation of the preamble lasted 800 msec. A deadline window appeared, 2 cm below the fixation point, 300 msec after the preamble disappeared from the screen. In this window, a bar was filled from left to right. When the bar was completely filled, a short tone announced the deadline was reached. Time from appearance of the deadline window to the deadline signal was 1140 msec. The participants were instructed to press a button in order to move from one trial to another.

At the beginning of the experimental session, a practice set of 10 items of the filler type was presented to the participants to complete. The experimental session was recorded on audiotape. Following the sentence completion task, the subjects were given a sheet of paper on which the same preambles were listed. They were instructed to rate the plausibility of each item on a 4-point rating scale, where 1 = very plausible and 4 = very implausible.

*Scoring.* The tape-recorded sessions were first transcribed and then assigned to one of the following scoring categories. *Correct responses* were scored when the participant said the preamble correctly and produced a correctly inflected verb form in the completion. *Agreement errors* were scored when the participant said the preamble correctly, but produced a wrongly inflected verb form. *Number repetition errors* were scored when the participant incorrectly reported the number of the sentential subject and then produced a verb form inflected correctly with the number of the subject already produced. *Repetition plus agreement errors* were scored when the participant changed the number of the head noun, but then the number of the verb form mismatched with the number of the subject already produced. Finally, utterances were scored as *miscellaneous responses* when the participant failed to report the preamble, omitted or substituted some words, said (part of) the preamble more than once, changed the number of the local noun, produced a sentence with a post-verbal subject, did not produce a complete sentence, or did not produce a verb form before the deadline signal. If two different utterances were produced in succession, only the first was scored, including those cases in which an agreement error was produced and immediately corrected.

*Design and Data Analysis.* The number of agreement errors and the number of miscellaneous responses constituted the dependent variables for the statistical tests. Two analyses of variance, one with subjects ( $F_1$ ) and the other with items ( $F_2$ ) as the random factor, were carried out for each dependent measure. The experimental factors orthogonally combined were (1) distributivity (single token vs multiple token) and (2) number match (match vs mismatch) between the head and the local noun. The combination of these two factors yielded four conditions. Each participant received six items in each condition.

Differences in the plausibility between single and multiple token items were assessed using analyses of variance with the same experimental factors as the production experiment. Furthermore, average plausibility ratings were treated as a covariate in an analysis of covariance which included the two main factors distributivity and number match.

## Results

*Production Experiment.* Application of the scoring criteria yielded 492 (64.1%) correct responses, 58 (7.6%) agreement errors and 3 (0.4%) repetition plus agreement errors. There were 16 (2%) number repetition errors and 199 (25.9%) miscellaneous responses.<sup>6</sup> Table 5 shows the

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<sup>6</sup>It is worth noting that the large majority of miscellaneous responses included cases in which the speaker did not supply a verb before the deadline was reached.

TABLE 5  
Distribution of Responses by Scoring Category in Experiment 1 (Dutch)

<i>Experimental Condition<sup>a</sup></i>	<i>Correct (n)</i>	<i>Agreement Errors (n)</i>	<i>Repetition Errors (n)</i>	<i>Agreement/Repetition Errors (n)</i>	<i>Miscellaneous Responses (n)</i>
ST, control	136	0	0	0	56
ST	114	6	10	0	62
MT, control	153	0	0	2	37
MT	89	52	6	1	44

<sup>a</sup>ST, control (single token, number match); ST (single token, number mismatch); MT, control (multiple token, number match); MT (multiple token, number mismatch).

distribution of responses in the different scoring categories for the experimental conditions.

As is clear from Table 5, agreement errors were most common ( $n = 52$ ) for multiple token preambles, while we found only six errors in the single token condition and no errors in the control (singular head noun, singular local noun) conditions.<sup>7</sup> The distribution of responses was different for number repetition and miscellaneous responses. Number repetition errors seemed to be limited to the conditions with a mismatch between the numbers of subject and local noun. Miscellaneous responses were more common for single token items than for multiple token items.

Since there were no agreement errors in the number match condition, the analysis of variance just contrasted single versus multiple token conditions. This difference was significant both by subjects and by items [ $F_1(1,31) = 39.52$ ,  $P < 0.001$ ;  $F_2(1,22) = 15.19$ ,  $P < 0.001$ ].

The analysis of variance conducted on miscellaneous responses revealed a significant effect of distributivity, but only in the test by subjects [ $F_1(1,31) = 15.03$ ,  $P < 0.001$ ;  $F_2(1,44) = 2.604$ ,  $P = 0.114$ ]. There was no significant effect of number match, nor was the interaction between these variables significant.

*Plausibility Ratings.* Data were gathered on only 30 of the 32 subjects, due to an omission on the part of the experimenter. Mean plausibility (1 = very plausible, 4 = very implausible) was 1.5 in the single token, plural local noun condition, 2.0 in the multiple token, plural local noun condition, and 1.3 in both control conditions. Preambles in the multiple token condition were rated as more implausible than in the other conditions. The analysis of variance on the plausibility ratings yielded significant main effects of distributivity [ $F(1,44) = 8.20$ ,  $P < 0.01$ ] and of number match [ $F(1,44) =$

<sup>7</sup>A similar pattern of results emerges when assignment to scoring categories does not take the deadline into account.

21.97,  $P < 0.001$ ]. The interaction was also significant [ $F(1,44) = 8.20$ ,  $P < 0.01$ ].

In order to test the role of plausibility in the production experiment, we performed an analysis of covariance on agreement errors, with plausibility as the covariate. The results of this analysis showed that the effect of distributivity cannot be attributed to a confound with plausibility. With plausibility as a covariate, the effect of distributivity remained [ $F(1,21) = 7.75$ ,  $P = 0.011$ ].

## Discussion

The main results of the present experiment can be summarised as follows. In the production experiment, agreement errors were reliably more common in the multiple token condition than in the single token condition. Miscellaneous responses were more frequent in the single token condition, regardless of the number of the local noun. Repetition errors were more frequent in the number mismatch conditions, regardless of distributivity. The multiple token items also received a significantly lower plausibility rate, but the difference between single and multiple token items in the production experiment was significant even when their plausibility was taken into account.

The finding of a distributivity effect in Dutch rules out the possibility that the cross-linguistic difference between English and Italian/Spanish can be accounted for in terms of being a null subject language or not. In fact, Dutch (like English) does not allow null subject sentences. However, the evidence from this first experiment is not conclusive, since the items in the multiple token condition were also judged to be less plausible than the items in the single token condition. In fact, although analysis of covariance showed that the distributivity effect was significant when plausibility was taken into account, it may be that multiple token items, being generally more implausible, induced an extremely high number of errors.

The second experiment, therefore, was carried out to see if we could replicate this result with a new set of materials judged equally plausible in both experimental conditions. The same variables were experimentally manipulated and the procedure was exactly the same.

## EXPERIMENT 2: DUTCH

### Method

*Participants.* Forty undergraduate students at the University of Nijmegen participated in the experiment, all of whom were native speakers of Dutch. They received course credit for their participation.



*Materials.* A new set of items was constructed for this experiment. As in Experiment 1, the items comprised sentential fragments consisting of a singular subject NP followed by a PP. Sixteen independent judges, all native speakers of Dutch, evaluated the preferred semantic reading of the preambles. The experimental items were classified as single or multiple token by at least 13 judges. There were 20 items, 10 of which were judged to be single token and 10 to be multiple token.

In addition, the items were subjected to a plausibility test for which four lists were constructed that included experimental items and filler items. Across the lists, each item occurred twice with a plural local noun and twice with a singular local noun. Forty subjects, none of whom participated in the production experiment, rated the items' plausibility on a 5-point rating scale, with a score of 1 being very plausible and 5 very implausible. Each item was judged by 20 subjects and each subject received five items in each condition. Mean plausibility was 1.30 for single token items, 1.47 for single token control items, 1.29 for multiple token items and 1.16 for multiple token control items. Although single token items were on average slightly more implausible, the effect of distributivity failed to reach conventional levels of significance [ $F(1,36) = 3.577$ ,  $P = 0.067$ ]. There was no effect of number match [ $F(1,36) < 1$ ], nor was the interaction significant [ $F(1,36) = 3.14$ ,  $P = 0.085$ ]. In Table 6, we report some examples of the new items.

TABLE 6  
Examples of Sentence Preambles Used in Experiment 2 (Dutch)

<i>Experimental Condition</i>	<i>Examples</i>
Single token, number match (ST, control)	De kerk bij de heuvel (The church near the hill)  De kooi met de gorilla (The cage with the gorilla)
Single token, number mismatch (ST)	De kerk bij de heuvels (The church near the hills)  De kooi met de gorillas (The cage with the gorillas)
Multiple token, number match (MT, control)	De puzzel in de krant (The puzzle in the newspaper)  De handtekening op de cheque (The signature on the cheque)
Multiple token, number mismatch (MT)	De puzzel in de kranten (The puzzle in the newspapers)  De handtekening op de cheques (The signature on the cheques)

Each preamble consisted of the same number of words ( $n = 5$ ). The number of syllables was on average greater in the multiple token set than in the single token set (8.0 vs 7.7), a difference that was not significant [ $t(18) = 0.46$ ,  $P = 0.65$ ]. The experimental items all contained head and local nouns of the non-neuter gender. That is, they all started with the same definite determiner, “de”, which is unmarked for number and therefore can be considered parallel to the English “the”. Local nouns either required the morpheme “en” or “s” to indicate plurality. This variable was balanced within the single and multiple token sets. All preambles are listed in Appendix 2.

There were 30 filler items, 20 of which had the same syntactic structure as the experimental items, but had a plural head noun. Half of these had a singular local noun, and half a plural local noun. The remaining 10 fillers were simple NPs, consisting of a determiner, one or more adjectives, and a noun. Simple NP fillers were singular in five cases and plural in five cases. Filler items all had head nouns of the non-neuter gender.

Four 50-item lists were created. Each list consisted of 20 experimental items (five single token items, five single token control items, five multiple token items and five multiple token control items) and 30 fillers. Across the four lists, each item contributed twice to the number match condition and twice to the number mismatch condition. In each list, the experimental and filler items were organised in a pseudo-random order, with the constraint that the list started with four fillers.

*Procedure and Scoring.* These were the same as for Experiment 1.

*Design and Data Analysis.* The number of agreement errors and the number of miscellaneous responses constituted the dependent variables for the statistical tests. Two analyses of variance, one with subjects ( $F_1$ ) and the other with items ( $F_2$ ) as the random factor, were carried out for each dependent measure. The factors orthogonally combined were (1) distributivity (single token vs multiple token) and (2) number match (match vs mismatch) between the head and the local noun. The combination of these two factors yielded four conditions. Each participant received five items in each condition.

## Results

Application of the scoring criteria yielded 498 (62.3%) correct responses, 36 (4.5%) agreement errors and 5 (0.6%) repetition plus agreement errors. There were 3 (0.4%) number repetition errors and 258 (32.3%) miscellaneous responses. In Table 7, the numbers of responses in the

different scoring conditions are reported. As is clear from the table, agreement errors were most common ( $n = 29$ ) in the multiple token condition, whereas we observed only five errors in the single token condition and one error in each of the control conditions.

Since there was only one agreement error in each of the number match conditions, the analysis of variance just contrasted single versus multiple token conditions. The effect of distributivity was reliable both by subjects and by items [ $F_1(1,39) = 11.80$ ,  $P < 0.001$ ;  $F_2(1,18) = 10.49$ ,  $P < 0.005$ ]. The analysis of variance conducted on miscellaneous responses revealed no significant main effects or interactions.

The agreement error rates for Experiment 2 were lower than for Experiment 1 (7.6% and 4.5%, respectively), while miscellaneous responses were more common in Experiment 2 than in Experiment 1 (32.2% and 25.9%, respectively). It is important to note that the items differed in the two experiments. In particular, the items in the multiple token set differed in their plausibility (lower in Experiment 1 than in Experiment 2), and they also differed in their length (on average, seven syllables in Experiment 1 and eight syllables in Experiment 2). In order to test for significant differences between the experiments, we conducted two analyses of covariance. In the first analysis, the dependent measure was the proportion of agreement errors for the different items (computed as the number of agreement errors in that condition over the total number of items presented in that condition). Experiment was treated as a between-item factor and the rated plausibility was entered as a covariate. This analysis failed to reveal a significant effect of Experiment ( $F < 1$ ) on agreement errors when the plausibility of the items was taken into account. In the second analysis, the dependent measure was the proportion of miscellaneous responses for the different items. Experiment was treated as a between-item factor and the length in syllables was entered as a covariate. This analysis failed to reveal a significant effect of Experiment ( $F < 1$ ) on miscellaneous responses when the length of the items was taken into account. It is important to mention here that the majority of

TABLE 7  
Distribution of Responses by Scoring Category in Experiment 2 (Dutch)

<i>Experimental Condition<sup>a</sup></i>	<i>Correct (n)</i>	<i>Agreement Errors (n)</i>	<i>Repetition Errors (n)</i>	<i>Agreement/Repetition Errors (n)</i>	<i>Miscellaneous Responses (n)</i>
ST, control	142	1	0	0	57
ST	131	5	1	0	63
MT, control	133	1	1	2	63
MT	92	29	1	3	75

<sup>a</sup>ST, control (single token, number match); ST (single token, number mismatch); MT, control (multiple token, number match); MT (multiple token, number mismatch).

responses scored as miscellaneous were in fact cases in which the participants did not produce a verb before the deadline signal. An increase in the length of the preamble to be repeated, therefore, can easily affect responses in this scoring category.

## Discussion

In this second experiment, we found a distributivity effect in Dutch. Items in the multiple token condition induced more agreement errors than items in the single token condition. Given this result, we must conclude that being a null subject language is not a necessary condition for the independent retrieval of number features for the subject NP and for the verb.

It is important to note that the presence of a distributivity effect in Dutch also rules out the two additional hypotheses put forward in the Introduction. The cross-linguistic difference is not due to some feature(s) of Romance languages, since we found an effect of distributivity in a Germanic language (i.e. Dutch). Furthermore, this result rules out the possibility that the number of morphological markers of number in the head or local noun phrases has any impact. In fact, in the present experiment, all the nouns used were introduced by the determiner “de”, which has the same morphological form for the singular and for the plural, parallel to “the” in English.

Since Dutch shares with Italian and Spanish the other two characteristics discussed (i.e. post-verbal subjects and rich verbal morphology), we could not decide between the two on the basis of these data alone. In the third and final experiment, we tested French.

## EXPERIMENT 3: FRENCH

In this experiment, we tested whether speakers of French are sensitive to the conceptual number of the subject in subject–verb agreement construction. As mentioned above, French shares with Italian/Spanish a rich verbal morphology, while it shares with English the facts that the subject pronoun is mandatory and that the subject pronoun always precedes the verb. From the previous experiments, we know that being a null subject language is not a necessary condition. The results of the present experiment therefore can tell us something about the role of the other two differences. If we find a distributivity effect in French, we must conclude that the possibility of having the subject after the verb is not important for retrieving information about the number of the subject from the conceptual representation when the verb phrase is computed.

In Experiment 3, we used visual presentation in order to provide the most clear number information to the speaker (since as previously discussed, the singular and plural phonetic form of regular nouns is indistinguishable). The visual presentation also allowed us to use a technique to increase subject–

verb agreement errors introduced by Vigliocco et al. (1995). This technique takes advantage of the fact that in French (as in Italian and Spanish), predicates agree in number (and gender) with the sentential subject, as is shown in (12):

- 12a. Le vase sur les tables est vert  
 The-M,S vase-M,S on the-F,P tables-F,P is green-M,S  
 b. Les vases sur la table sont verts  
 The-M,P vases-M,P on the-F,S table-F,S are green-M,P

Note also for adjectives that the singular and plural forms are distinguishable only in the written format as, apart from a few exceptions, they are pronounced the same.

The adjective (singular or plural) was presented visually and immediately followed by the sentential preamble. The participants' task was to turn the preamble into a full sentence using in their completions the adjective they saw previously. For example, the participants saw "vert" [green] and then "Le vase sur les tables" [The vase on the tables]. Their task was to say something like "Le vase sur les tables est vert" [The vase on the tables is green]. The adjective was *congruent*, in that it had the same number as the head noun (adjective singular, head noun singular), or *incongruent*, with a different number (adjective plural, head noun singular). The rationale underlying the use of this manipulation is that when the adjective is mismatching (i.e. plural), it should increase the likelihood of finding agreement errors, since when the preamble is presented, the participants have already read the adjective. The adjective congruent condition served as the control condition in order to ensure that the mere introduction of the adjective did not increase the error rates for unrelated reasons. A further advantage of the use of this methodology is that the participants were required to use the verb "être" [to be] in their utterances. The conjugations of this verb are never ambiguous with respect to number (see Table 2).

It is important to note that there were a few differences between Experiments 1 and 2 and the present experiment. First, the methodology differed; second, in the present experiment, there were no control conditions with a number matching local noun. This latter difference was motivated in part by the results of a pilot experiment conducted in French in which subjects could freely complete the sentential preambles and in which the number control conditions were present. The pattern of results of that experiment was similar to that in Dutch—the multiple token items elicited more errors ( $n = 9$ ) than single token items ( $n = 2$ ), and fewer errors were found in the number control conditions; however, the overall error rate was surprisingly low (1.6%). Finally, we did not use parallel versions of the materials in the different languages for the following reasons. First, and most important, certain items univocally classified as single or multiple token in a

language did not receive a univocal judgement in the other language; second, languages differ in the use of certain prepositions to represent a given relation.

## Method

*Participants.* Fifty-six students at the University of Montreal aged 19–25 years participated in the experiment. They were native speakers of (Quebecian) French and they volunteered or received course credit for their participation. Ten additional subjects from the same pool evaluated the plausibility of the materials. Before starting the experiment, a questionnaire, investigating level of proficiency in French, was presented to the participants. As a general criterion, French not only had to be the first language they acquired but also they (a) had to have attended up to high school in a French school, and (b) they had to use French at least 90% of the time during everyday activities.

*Materials.* The basic materials for the present experiment consisted of sentential preambles composed of a subject NP followed by a PP. All the experimental items had a singular head noun and a plural local noun. Half were classified as single token and half as multiple token. The preferred semantic reading of the preambles was evaluated by 16 independent judges, all native speakers of French. Only those items unambiguously classified as single or multiple token by at least 12 judges were included in the experiment. In addition to the experimental items, a set of filler items was also created. Each experimental and filler item was matched with a semantically plausible adjective.

Each preamble consisted of the same number of words ( $n = 5$ ). The number of syllables was not significantly different in the two sets of materials [single token = 6.38, multiple token = 6.13;  $t(30) = 0.52$ ,  $P = 0.61$ ]. The gender of the head noun and of the local noun was balanced; therefore, there were four preambles in which both head and local noun were masculine, four preambles in which the head was masculine and the local noun was feminine, four in which both head and local noun were feminine, and four in which the head was feminine and the local noun was masculine. The gender of the filler items was also balanced. All the nouns used in the experiment were regular in that the singular and plural forms were pronounced identically.

Two 64-item lists were created. In each list, there were 32 experimental items (16 single token and 16 multiple token) and 32 filler items. Sixteen of the filler items were NP–PP preambles, with a plural head and a plural local noun; the other 16 were simple NP preambles, 8 of which were singular and 8 plural. The items were preceded by a singular adjective in one list and by a plural adjective in the other list. In Table 8 we report some examples of the

experimental sentence preambles (all the experimental sentence preambles are reported in Appendix 3).

Experimental and filler items were arranged in the lists in a pseudo-random order. Each list started with five fillers. The arrangement of the remaining experimental and filler items was randomised, with the constraint that no more than three experimental items appeared in succession.

The same experimental and filler items were presented to an additional group of 10 subjects requested to provide plausibility ratings on the materials using a 4-point scale (1 = very plausible, 4 = very implausible). Single token items received a mean plausibility score of 1.8, whereas multiple token items received a mean score of 1.9. The difference was not significant [ $t(30) = 0.71$ ,  $P = 0.48$ ].

*Procedure.* Each participant was tested individually in sessions lasting about 10 min. After a warning signal which initiated the trial, the adjective was presented at the centre of a computer screen for 600 msec, followed by an interval of 600 msec and then the preamble for 900 msec. The exposure durations for the adjective and the preamble were considered the shortest possible if the subjects were to correctly read the adjective and the preamble (Vigliocco et al., 1995). For example, they saw “incompétents” [incompetent] and then “Le mécanicien des voitures” [The mechanic of the

TABLE 8  
Examples of Sentential Preambles in the Different Experimental Conditions in Experiment 3 (French) with Adjectives in Parentheses

<i>Experimental Condition</i>		<i>Examples</i>
Singular adjective, single token (SAdj, ST)	(fatigué) (tired)	Le lecteur des romans The reader of the novels
	(arrivé) (arrived)	Le témoin des avocats' The witness of the lawyers
Plural adjective, single token (PAdj, ST)	(fatigués) (tired)	Le lecteur des romans The reader of the novels
	(arrivés) (arrived)	Le témoin des avocats' The witness of the lawyers
Singular adjective, multiple token (SAdj, MT)	(varié) (varied)	Le menu des restaurants The menu of the restaurants
	(dorée) (golden)	L'étiquette des bouteilles The label on the bottles
Plural adjective, multiple token (PAdj, MT)	(neufs) (new)	L'uniforme des soldats The uniform of the soldiers
	(spacieux) (large)	Le bureau des gérants The office of the directors

cars] and had to produce a sentence like “Le mécanicien des voitures est incompetent” [The mechanic of the cars is incompetent], thus changing the number of the adjective in this case. The written instructions emphasised rapid speech and gave examples of possible sentences both with a congruent and an incongruent adjective. The subjects had, in fact, to be ready to find incongruence between the number of the head noun and the number of the adjective, but no mention of grammatical number was made. Since we did not want the participants to change the number of the head noun, the instructions also emphasised that the preamble had always to be repeated as shown. Adjective–preamble pairs were presented one at a time. The subjects were instructed to press the space bar on the computer keyboard in order to move from one trial to the next.

If a participant failed to read or comprehend either the adjective or the preamble, the experimenter repeated it back to him or her. At the beginning of the experimental session, a practice set of eight NP–PP items (four with a congruent and four with an incongruent adjective) was presented to the participants to complete. The experimental sessions were tape-recorded using an analog recording system.

*Scoring.* The utterances produced were transcribed and then placed in one of the following scoring categories. *Correct responses* were scored when the participant said the preamble correctly and produced a correctly inflected verb form in the completion. *Agreement errors* were scored when the participant said the preamble correctly, but produced a wrongly inflected verb form. Responses in this category were further divided into: (1) *errors in the agreement of number*, when the verb form produced mismatched in number with the sentential subject (i.e. when they produced plural verbs), and (2) *others*, when the predicate disagreed with the subject in gender or number. *Repetition errors* were scored when the participant incorrectly reported the number of the sentential subject and then produced a verb form inflected correctly with the number of the subject already produced. *Repetition plus agreement errors* were scored when the participant changed the number of the head noun but then the number of the verb form mismatched with the number of the subject they produced. Finally, utterances were scored as *miscellaneous responses* when the participant failed to report the adjective, the preamble (or part of it), substituted some words or did not produce a verb form. If two different utterances were produced in succession, only the first was scored, including those cases in which an agreement error was produced and immediately corrected.

*Design and Data Analysis.* The number of agreement errors, the number of repetition responses and the number of miscellaneous responses constituted the dependent variables for the statistical tests. Two analyses of variance, one with subjects ( $F_1$ ) and the other with items ( $F_2$ ) as the random



factor, were carried out for each dependent measure. The factors orthogonally combined were (1) distributivity (single token *vs* multiple token) and (2) number of the adjective (congruent *vs* incongruent). The combination of these two factors yielded four conditions. Each participant received eight items in each condition.

## Results

Application of the scoring criteria yielded 1492 (83.33%) correct responses, 65 (3.63%) agreement errors—of which 63 were errors in the agreement of number and two were “other” agreement errors—and 10 (0.55%) repetition plus agreement errors. There were 110 (6.14%) repetition errors and 115 (6.42%) miscellaneous responses. Table 9 shows the distribution of responses in the different scoring categories for the experimental conditions. As can be seen, agreement errors were more common for multiple token items than for single token items and when the adjective was incongruent with the subject head noun.

TABLE 9  
Distribution of Responses by Scoring Category in Experiment 3 (French)

<i>Experimental Condition<sup>a</sup></i>	<i>Correct (n)</i>	<i>Agreement Errors (n)</i>	<i>Repetition Errors (n)</i>	<i>Agreement/Repetition Errors (n)</i>	<i>Miscellaneous Responses (n)</i>
SAdj, ST	373	8	26	5	36
PAdj, ST	364	13	40	4	27
SAdj, MT	395	10	17	0	26
PAdj, MT	360	34	27	1	26

<sup>a</sup>SAdj, ST (singular adjective, single token); PAdj, ST (plural adjective, single token); SAdj, MT (singular adjective, multiple token); PAdj, MT (plural adjective, multiple token).

The analyses of variance conducted on errors in the agreement of number showed a significant effect of distributivity [ $F_1(1,55) = 6.19$ ,  $P = 0.016$ ;  $F_2(1,30) = 5.90$ ,  $P = 0.021$ ]: errors were more common for multiple than for single token preambles. The congruency between the number of the adjective and the number of the head noun was significant [ $F_1(1,55) = 11.51$ ,  $P < 0.001$ ;  $F_2(1,30) = 11.31$ ,  $P = 0.002$ ], as was the interaction between the two factors [ $F_1(1,55) = 4.7$ ,  $P = 0.05$ ;  $F_2(1,30) = 5.35$ ,  $P = 0.03$ ].

It is worth noting that in the present experiment the adjective was at times a plausible modifier of the head noun only, and at other times it was a plausible modifier of both the head and the local noun. It can be argued that, in this second case, plural verbs (scored as agreement errors) may reflect erroneous selection of the sentential subject.<sup>8</sup> That is, the local plural noun is

<sup>8</sup>We thank Michel Fayol for directing our attention to this important point.

taken as the subject of the sentence and therefore a plural verb would be correct (since the local noun was always plural in this experiment). However, in order to obtain a difference in error frequencies between single and multiple token preambles due to this confound, items in which the adjective was a plausible modifier of the local noun should have been more common among the multiple token than the single token preambles. This was not the case in our experiment: 6 of 16 items in the multiple token set and 8 of 16 items in the single token set were of this kind. Furthermore, if we consider those cases in which the adjective plausibly modified only the head noun ("pure cases"), the error rates in the single token and in the multiple token conditions closely matched the overall rates in these two conditions. The error rate for single token "pure cases" was 0.02, whereas for multiple token "pure cases" it was 0.054. The overall error rate for single token items was also 0.02, whereas for multiple token items it was 0.05.

The analyses of variance carried out on number repetition errors showed a significant main effect of the congruency between the number of the adjective and of the head noun [ $F_1(1,55) = 11.37$ ,  $P = 0.001$ ;  $F_2(1,30) = 6.32$ ,  $P = 0.018$ ]. Repetition errors were also more common in the single token condition than in the multiple token condition; this effect, however, was significant by subjects [ $F_1(1,55) = 10.48$ ,  $P = 0.002$ ] but not by items [ $F_2(1,30) = 2.51$ ,  $P = 0.12$ ].

Finally, miscellaneous responses were not influenced either by distributivity or congruency between the adjective and the subject head noun.

## Discussion

The results of Experiment 3 can be summarised as follows. The distributivity of the subject head noun influenced the agreement error rates but not the rates for repetition and miscellaneous responses. Only agreement errors were more common after multiple token than single token preambles. The procedure of presenting an incongruent adjective prior to the preamble was successful in eliciting a fair percentage of agreement errors (error rates went from 1.6% in our pilot study in which we used a free completion task to 3.6% in this study).

The numbers of repetition errors and repetition plus agreement errors were much larger in Experiment 3 than in Experiments 1 and 2. This can probably be best explained by the difference in methodology. In Experiment 3, the subject was presented with a number marked adjective. It is conceivable that the presence of an additional number cue, conflicting half of the time with the head noun, led to a greater probability of confusing the number of the head and local noun.

The finding of a distributivity effect in French allows us to exclude both the possibility of dropping the subject pronoun and of having the subject after the verb as factors determining the independent retrieval of number features for the subject and for the verb.

## GENERAL DISCUSSION

This series of experiments extends previous investigations of conceptual agreement to Dutch and French. The conceptual variable we considered was distributivity. In previous studies (Bock & Miller, 1991; Vigliocco et al., 1995, *in press*), English did not show any effect of this variable, whereas Italian and Spanish did. The main aim of the present study was to assess a number of psychologically plausible hypotheses which have been put forward to explain this cross-language difference. These hypotheses try to relate the different behaviour of these languages to their structural properties. The present study of Dutch and French was therefore motivated by the fact that these two languages share some structural properties with either English or Italian (and Spanish). We found an effect of distributivity in both French and Dutch, and in Fig. 2 we report the proportions of agreement errors in the single and multiple token conditions for all the languages studied.

In the Introduction, three main structural differences were proposed in order to account for the different results in Italian/Spanish and English: the possibility of dropping the subject pronoun, the possibility of having post-verbal subjects and the richness of the verbal morphology. The experiments reported in this paper allow us to conclude that neither the possibility of dropping the subject nor the possibility of having post-verbal subjects can account for the results obtained. Specifically, the finding of a distributivity effect in Dutch allows us to exclude the first hypothesis and the finding of a distributivity effect in French allows us to exclude both the first and the second hypotheses.

The present results also allow us to conclude that the cross-linguistic difference has nothing to do with being a Romance versus a Germanic language, since we found a distributivity effect in Dutch. Furthermore, the results rule out the possibility that the difference was related to the number of morphological markers for number in the experimental NP (i.e. number information is or is not redundantly present on the determiner and on the noun): we found a distributivity effect in Dutch, using preambles in which the determiner did not give any information about number (as it was the case for the English materials).

It is worth mentioning again here that the same preambles which did not induce any difference in subject-verb agreement in English (Bock & Miller, 1991) did show an effect of distributivity when subject-pronoun agreement

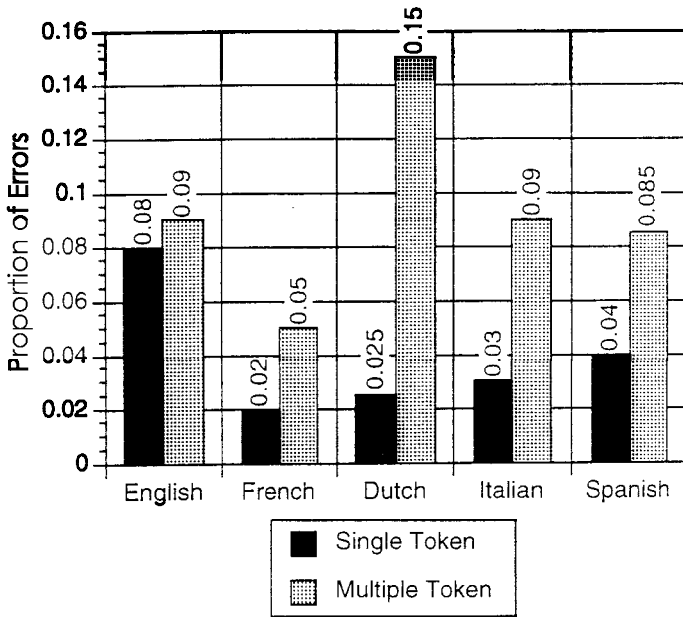


FIG. 2. Proportions of agreement errors for the different languages tested (proportions are computed as the number of agreement errors over the total number of items in that condition). Data for English, Italian and Spanish are taken, with the authors' permission, from Vigliocco et al. (in press).

was considered (Bock et al., 1992); therefore, the absence of an effect in English does not seem to be easily attributed to idiosyncrasies of the experimental materials.

In the linguistic literature, the fact that different languages can be sensitive to conceptual number for different agreement relations has been observed and discussed. Starting with the study of Slavic languages, Corbett (1979, 1983) postulated that the probability of conceptual agreement, rather than syntactic agreement, increases as the agreement target occupies a rightward position in the following series of syntactic positions: attributive modifier, predicate, relative pronoun, personal (anaphoric) pronoun. Different languages can occupy different positions in this hierarchy and, if a language allows conceptual agreement at a certain agreement position (e.g. relative pronoun) in the hierarchy, it should allow conceptual agreement for all positions to the right (personal pronoun in the example above). The sentence in (13) is a further example. In Italian, for nouns such as "guardia" [guard], which are grammatically feminine but typically refer to men, gender agreement between subject and verb is with the grammatical gender, but gender agreement between subject and anaphoric pronoun is with natural (conceptual) gender.

13. La guardia è arrivata tardi, (lui) è stato  
 The-F,S guard-F,S is-3p,S arrived-F,S late, (he) is-3p,S been-M,S  
 a parlare con il direttore.  
 to talk with the director.

The finding of a distributivity effect for tag questions (Bock et al., 1992; Bock, 1995) is also important, since it shows that English speakers can be sensitive to the distributivity dimension but in a position further to the right in the hierarchy. Additional data showing a conceptual influence on the relation between subject and anaphoric pronoun in English and Spanish comes from work by Gernsbacher and colleagues (Carreiras & Gernsbacher, 1992; Gernsbacher, 1991; Oakhill, Garnham, Gernsbacher, & Cain, 1992). These authors report a series of experiments exploring the comprehension of “conceptual anaphors”, such as “I think I’ll order a frozen margarita. I just love THEM”, both in English and Spanish. They found that conceptual anaphors are quickly read and easily understood in both languages.

Extrapolating from this proposal, conceptual agreement could be found in English for targets in a position further to the right of the hierarchy than in all other languages tested. The data regarding subject–pronoun agreement in English are compatible with this view. Furthermore, a prediction that can be derived from this proposal is that Dutch, French, Italian and Spanish should allow conceptual agreement for subject–pronoun relations (a more extensive discussion of this issue can be found in Vigliocco et al., in press).

In the framework of a processing model, the agreement hierarchy may represent the points, during the encoding of a sentence, at which features such as number are retrieved from the conceptual representation. Therefore, which properties of a language determine its position on the agreement hierarchy? The only structural difference we did not rule out in the present study was the richness of verbal morphology.

It is not immediately clear why this should be the case; that is, why the independent retrieval of number features for the subject and for the verb should be possible only if number is expressed in the verb phrase. However, one possible reason is that in English the verbal inflectional morphology is *meaningless*, while it is *meaningful* in the other languages tested (i.e. in contrast to the other languages tested, English verb inflections do not carry information about how many participants are in the scenario described by the sentence).

According to this possibility, since the verbal morphology of English is limited to a distinction between a marked form (the third person singular) and all other forms, in most cases it does not carry any meaning of number. In the other languages tested, since the verb form carries information about number, the verb form is meaningful with respect to number. Some evidence

compatible with this idea comes from language acquisition studies. Berko (1958) and Keeney and Smith (1971) showed that noun number inflections are produced prior to verb number inflections by English children. Keeney and Wolfe (1972) reported that English-speaking 3- to 4-year-olds performed at chance level when required to choose between a picture depicting one bird and another depicting two birds when the verb form "sing" or "sings" was presented. In the same task, the children's performance was better than chance if the whole of the sentence was presented. The cross-linguistic data reported by a number of researchers on sentence interpretation (Bates et al., 1982; Kail, 1989; Kilborn & Cooreman, 1987; MacWhinney, Bates, & Kliegl, 1984; McDonald & Heilenman, 1991) are also compatible with this view. These authors used a sentence interpretation paradigm in which subjects were required to choose the subject/agent of a sentence with a structure like (14) (from MacWhinney et al., 1984, p. 139):

- 14a. Licks the cow the goat
- b. Lecca la mucca la capra
- c. Leckt die Kuh die Ziege

In these experiments, the authors manipulated and placed in "competition" different *cues* (such as agreement, animacy, stress and word order) in an attempt to establish which cues are most relevant for speakers of different languages. MacWhinney et al. (1984) found that Italian speakers relied on agreement to make decisions about the subject/agent of the sentence, while English speakers relied overwhelmingly on word order. Dutch, French and Spanish behave like Italian in this respect: Kilborn and Cooreman (1987) showed that speakers of Dutch rely more on agreement than on word order, and Kail (1989) and McDonald and Heilenman (1991) showed the same for French and Spanish. It is important to note that what the authors refer to with the label "agreement" is in fact the number marking on the verb. According to this view, number information is retrieved from the discourse model only when the syntactic constituent has a "number meaning", otherwise it is just inherited from the agreement controller: in English subject-verb agreement, the number feature on the verb is inherited from the subject; in subject-pronoun agreement, it is taken from the discourse model, since the pronoun has a "number meaning". Further research is necessary in order to see if English speakers do not attribute any number meaning to the verb form while speakers of other languages do.

A word of caution is necessary here. The cross-linguistic differences reported in this paper have been discussed in terms of production mechanisms. However, further research is required to test the role of the comprehension component of the task. In fact, our results do not rule out the possibility that the cross-linguistic differences reported here are related to

different on-line interpretations of the preambles for speakers of different languages. Two unpublished studies seem to support this possibility. Eberhard (personal communication) found a significant effect of distributivity with a different set of materials and Vigliocco and Veres (in prep.) found an effect of distributivity in English using modified versions of the preambles used by Vigliocco et al. (in press). Although at present it is difficult to explain such findings, if replicated these studies would show that indeed agreement in English and in the other languages is computed in the same way (i.e. through unification) and that the difference originally found between English and the other languages tested may be attributed to differences in the interpretation of the linguistic input.

Whatever the final explanation turns out to be, our experiments have clearly excluded two psycholinguistically well-founded hypotheses: that retrieval from the conceptual representation of number information in subject-verb agreement depends on the possibility of omitting subject pronouns, and that it depends on the possibility of having post-verbal subjects.

The present experiments also stress once more the importance of cross-linguistic research on agreement phenomena. Though the assumption is that the same general architecture underlies language production in different languages, nonetheless the system can be differentially "tuned" to specific properties of a language. This seems to be the case in other domains of psycholinguistics such as speech segmentation (Cutler, Mehler, Norris, & Segui, 1986), where it has been shown that the speakers of different languages rely on different information in order to extract words from the speech stream (i.e. English speakers use stress location, whereas French speakers use syllabification).

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## APPENDIX 1

### *Experimental sentence preambles for Experiment 1.*

#### **Single token**

- De aanslag op de minister/s  
(the strike on the minister/s)
- De arts van de zieke/n  
(the doctor of the sick person/s)
- De baby op de foto's  
(the baby on the photo/s)
- De beker voor de winnaar/s  
(the cup for the winner/s)
- De boodschap voor de reiziger/s  
(the message for the traveller/s)
- De diefstal van de diamant/en  
(the theft of the diamond/s)
- De discussie over de drug/s  
(the discussion about the drug/s)
- De eigenaar van de koffer/s  
(the owner of the suitcase/s)
- De eis van de ontvoerder/s  
(the demand of the kidnapper/s)
- De klacht van de scholier/en  
(the complaint of the student/s)

De monteur van de motorfiets/en  
 (the mechanic of the motorcycle/s)  
 De regisseur van de film  
 (the director of the movie/s)

### Multiple token

De afbeelding op de mok/ken  
 (the picture on the mug/s)  
 De bel op de fiets/en  
 (the bell on the bicycle/s)  
 De beschrijving in de gids/en  
 (the description in the guide/s)  
 De bon in de folder/s  
 (the coupon in the flyer/s)  
 De datum op de munt/en  
 (the date on the coin/s)  
 De ingang van de flat/s  
 (the entrance of the apartment/s)  
 De kraag van de jas/sen  
 (the collar of the coat/s)  
 De leuning van de stoel/en  
 (the back of the chair/s)  
 De paraaf op de declaratie/s  
 (the initials (singular) on the declaration/s)  
 De reclame op de bus/sen  
 (the advertisement on the bus/ses)  
 De sleutel van de kast/en  
 (the key of the cupboard/s)  
 De stop op de fles/sen  
 (the stopper on the bottle/s)

## APPENDIX 2

*Experimental sentence preambles for Experiment 2.*

### Single token

De actie tegen de kerncentrale/s  
 (the protest against the nuclear plant/s)  
 De diefstal van de diamant/en  
 (the theft of the diamond/s)  
 De discussie over de startbaan  
 (the discussion about the runway/s)  
 De doos met de moorkop/pen  
 (the box with the moorkop/pen [Dutch pastry])  
 De intocht van de tank/s  
 (the entry of the tank/s)  
 De kerk bij de heuvel  
 (the church near the hill/s)  
 De kooi met de gorilla  
 (the cage with the gorilla/s)

De muur met de decoratie/s  
 (the wall with the decoration/s)  
 De vaas met de zonnebloem/en  
 (the vase with sunflower/s)  
 De weg naar de berg/en  
 (the road to the mountain/s)

### Multiple token

De afbeelding op de mok/ken  
 (the picture on the mug/s)  
 De chip in de computer/s  
 (the chip in the computer/s)  
 De handtekening op de cheque/s  
 (the signature on the cheque/s)  
 De inscriptie in de ring/en  
 (the inscription in the ring/s)  
 De kop op de gulden/s  
 (the head on the guilder/s)  
 De magneetstrip op de bankpas/sen  
 (the magnetic strip on the bankcard/s)  
 De medaille voor de Vierdaagselopers  
 (the medal for the four-day-marches walker/s)  
 De plaatsnaam op de wegwijzer/s  
 (the city name on the roadsign/s)  
 De puzzel in de krant/en  
 (the puzzle in the newspaper/s)  
 De reclame op de bus/sen  
 (the advertisement on the bus/ses)

## APPENDIX 3

*Experimental materials (adjective–preamble pairs) for Experiment 3.*

### Single token

fatigué Le lecteur des romans  
 (tired, The reader of the novels)  
 mignon Le cadeau des bébés  
 (small, The present for the babies)  
 célèbre Le réalisateur des films  
 (famous, The director of the movies)  
 arrivé Le témoin des avocats  
 (arrived, The witness of the lawyers)  
 rouge Le foulard aux roses  
 (red, The scarf with the roses)  
 réussi Le portrait des lauréates  
 (good, The picture of the graduates)  
 long Le chemin à travers les forêts  
 (long, The trail across the forests)  
 incompétent Le mécanicien des voitures  
 (incompetent, The mechanic of the cars)

pittoresque La ville près des collines  
 (picturesque, The village near the hills)  
 généreuse La marraine des filles  
 (generous, The godmother of the girls)  
 lavée La casserole aux poignées  
 (washed, The pot with the handles)  
 chaleureuse La lettre des tantes  
 (warm, The letter from the aunt)  
 triste La chanson des compositeurs  
 (sad, The song by the composers)  
 spacieux La maison des cousins  
 (large, The house of the cousins)  
 panoramique La route vers les lacs  
 (scenic, The road to the lakes)  
 définitive La réponse des experts  
 (final, The response by the experts)

### Multiple token

varié Le menu des restaurants  
 (varied, The menu of the restaurants)  
 feutré Le chapeau des hommes  
 (lining, The hat of the men)  
 étranger Le prénom des enfants  
 (foreigner, The name of the babies)  
 spacieux Le bureau des gérants  
 (large, The office of the directors)  
 illisible Le numéro des plaques  
 (unreadable, The number on the car-plates)  
 souriant L'agent aux intersections  
 (smiling, The cop at the intersections)  
 vert Le vase sur les tables  
 (green, The vase on the tables)  
 honnête Le maire des villes  
 (honest, The mayor of the villages)  
 dorée L'étiquette des bouteilles  
 (golden, The label on the bottles)  
 chère La radio sur les étagères  
 (expensive, The radio on the shelves)  
 effacée L'étampe sur les enveloppes  
 (cancelled, The stamp on the envelopes)  
 brisée La cloche des écoles  
 (broken, The bell of the schools)  
 belle La reproduction des livres  
 (beautiful, The copy of the books)  
 neuf L'uniforme des soldats  
 (new, The uniform of the soldiers)  
 blonde L'héroïne des films  
 (blonde, The heroine of the movies)  
 noire La tache sur les pantalons  
 (black, The stain on the pants)

